



Full wwPDB X-ray Structure Validation Report ⓘ

May 18, 2020 – 01:19 am BST

PDB ID : 6OXH
Title : X-ray crystal structure of His-tagged Y140F FtmOx1 bound to Fe(II) and 2-oxoglutarate
Authors : Dunham, N.P.; Boal, A.K.
Deposited on : 2019-05-13
Resolution : 1.92 Å(reported)

This is a Full wwPDB X-ray Structure Validation Report for a publicly released PDB entry.

We welcome your comments at validation@mail.wwpdb.org

A user guide is available at

<https://www.wwpdb.org/validation/2017/XrayValidationReportHelp>

with specific help available everywhere you see the ⓘ symbol.

The following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

MolProbity : 4.02b-467
Mogul : 1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix) : 1.13
EDS : 2.11
Percentile statistics : 20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac : 5.8.0158
CCP4 : 7.0.044 (Gargrove)
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.11

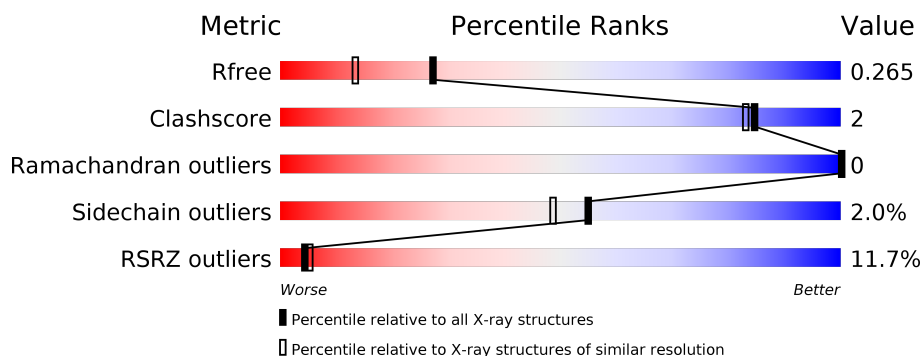
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.92 Å.

Percentile scores (ranging between 0-100) for global validation metrics of the entry are shown in the following graphic. The table shows the number of entries on which the scores are based.



Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
R_{free}	130704	7937 (1.94-1.90)
Clashscore	141614	8644 (1.94-1.90)
Ramachandran outliers	138981	8530 (1.94-1.90)
Sidechain outliers	138945	8530 (1.94-1.90)
RSRZ outliers	127900	7793 (1.94-1.90)

The table below summarises the geometric issues observed across the polymeric chains and their fit to the electron density. The red, orange, yellow and green segments on the lower bar indicate the fraction of residues that contain outliers for ≥ 3 , 2, 1 and 0 types of geometric quality criteria respectively. A grey segment represents the fraction of residues that are not modelled. The numeric value for each fraction is indicated below the corresponding segment, with a dot representing fractions $\leq 5\%$. The upper red bar (where present) indicates the fraction of residues that have poor fit to the electron density. The numeric value is given above the bar.

Mol	Chain	Length	Quality of chain
1	A	313	
1	B	313	

2 Entry composition

There are 4 unique types of molecules in this entry. The entry contains 4603 atoms, of which 0 are hydrogens and 0 are deuteriums.

In the tables below, the ZeroOcc column contains the number of atoms modelled with zero occupancy, the AltConf column contains the number of residues with at least one atom in alternate conformation and the Trace column contains the number of residues modelled with at most 2 atoms.

- Molecule 1 is a protein called Verruculogen synthase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	285	Total	C	N	O	S	0	0	0
			2253	1432	395	413	13			
1	B	289	Total	C	N	O	S	0	0	0
			2280	1448	399	420	13			

There are 46 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-20	MET	-	initiating methionine	UNP Q4WAW9
A	-19	GLY	-	expression tag	UNP Q4WAW9
A	-18	SER	-	expression tag	UNP Q4WAW9
A	-17	SER	-	expression tag	UNP Q4WAW9
A	-16	HIS	-	expression tag	UNP Q4WAW9
A	-15	HIS	-	expression tag	UNP Q4WAW9
A	-14	HIS	-	expression tag	UNP Q4WAW9
A	-13	HIS	-	expression tag	UNP Q4WAW9
A	-12	HIS	-	expression tag	UNP Q4WAW9
A	-11	HIS	-	expression tag	UNP Q4WAW9
A	-10	SER	-	expression tag	UNP Q4WAW9
A	-9	SER	-	expression tag	UNP Q4WAW9
A	-8	GLY	-	expression tag	UNP Q4WAW9
A	-7	LEU	-	expression tag	UNP Q4WAW9
A	-6	VAL	-	expression tag	UNP Q4WAW9
A	-5	PRO	-	expression tag	UNP Q4WAW9
A	-4	ARG	-	expression tag	UNP Q4WAW9
A	-3	GLY	-	expression tag	UNP Q4WAW9
A	-2	SER	-	expression tag	UNP Q4WAW9
A	-1	HIS	-	expression tag	UNP Q4WAW9
A	0	MET	-	expression tag	UNP Q4WAW9
A	140	PHE	TYR	engineered mutation	UNP Q4WAW9
A	292	LEU	-	expression tag	UNP Q4WAW9
B	-20	MET	-	initiating methionine	UNP Q4WAW9
B	-19	GLY	-	expression tag	UNP Q4WAW9

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Chain	Residue	Modelled	Actual	Comment	Reference
B	-18	SER	-	expression tag	UNP Q4WAW9
B	-17	SER	-	expression tag	UNP Q4WAW9
B	-16	HIS	-	expression tag	UNP Q4WAW9
B	-15	HIS	-	expression tag	UNP Q4WAW9
B	-14	HIS	-	expression tag	UNP Q4WAW9
B	-13	HIS	-	expression tag	UNP Q4WAW9
B	-12	HIS	-	expression tag	UNP Q4WAW9
B	-11	HIS	-	expression tag	UNP Q4WAW9
B	-10	SER	-	expression tag	UNP Q4WAW9
B	-9	SER	-	expression tag	UNP Q4WAW9
B	-8	GLY	-	expression tag	UNP Q4WAW9
B	-7	LEU	-	expression tag	UNP Q4WAW9
B	-6	VAL	-	expression tag	UNP Q4WAW9
B	-5	PRO	-	expression tag	UNP Q4WAW9
B	-4	ARG	-	expression tag	UNP Q4WAW9
B	-3	GLY	-	expression tag	UNP Q4WAW9
B	-2	SER	-	expression tag	UNP Q4WAW9
B	-1	HIS	-	expression tag	UNP Q4WAW9
B	0	MET	-	expression tag	UNP Q4WAW9
B	140	PHE	TYR	engineered mutation	UNP Q4WAW9
B	292	LEU	-	expression tag	UNP Q4WAW9

- Molecule 2 is FE (II) ION (three-letter code: FE2) (formula: Fe).

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
2	B	1	Total Fe 1 1	0	0
2	A	1	Total Fe 1 1	0	0

- Molecule 3 is 2-OXOGLUTARIC ACID (three-letter code: AKG) (formula: C₅H₆O₅).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
3	A	1	Total	C	O	0	0
			10	5	5		
3	B	1	Total	C	O	0	0
			10	5	5		

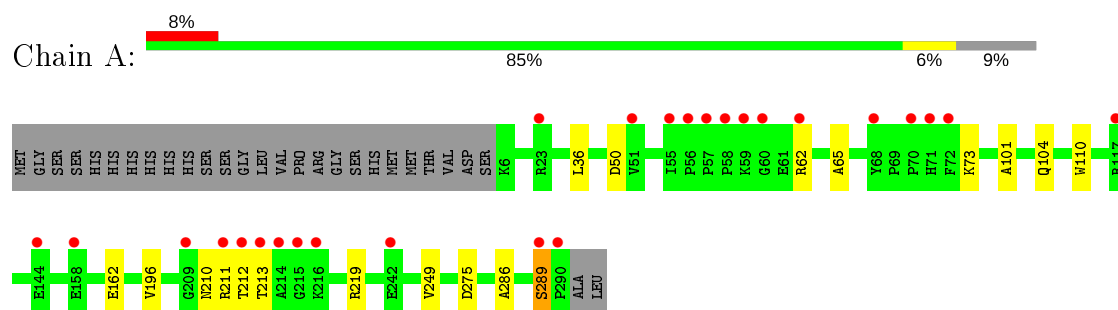
- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	25	Total	O	0	0
			25	25		
4	B	23	Total	O	0	0
			23	23		

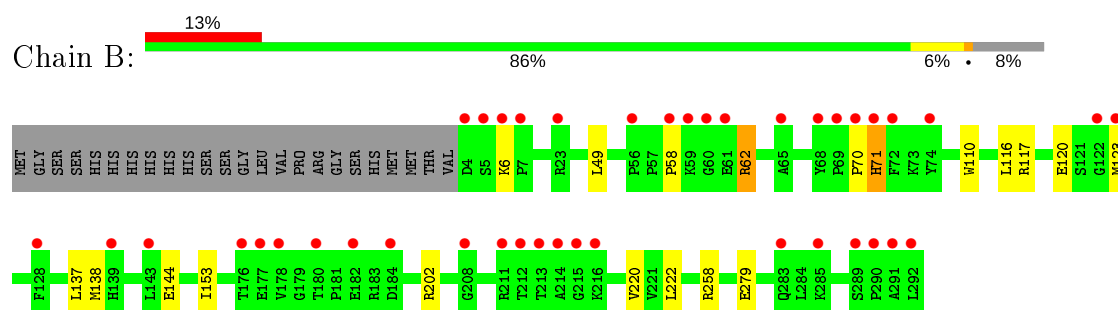
3 Residue-property plots [i](#)

These plots are drawn for all protein, RNA and DNA chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry and electron density. Residues are color-coded according to the number of geometric quality criteria for which they contain at least one outlier: green = 0, yellow = 1, orange = 2 and red = 3 or more. A red dot above a residue indicates a poor fit to the electron density ($RSRZ > 2$). Stretches of 2 or more consecutive residues without any outlier are shown as a green connector. Residues present in the sample, but not in the model, are shown in grey.

- Molecule 1: Verruculogen synthase



- Molecule 1: Verruculogen synthase



4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	73.51Å 79.36Å 91.51Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	59.96 – 1.92 39.64 – 1.92	Depositor EDS
% Data completeness (in resolution range)	85.6 (59.96-1.92) 85.7 (39.64-1.92)	Depositor EDS
R_{merge}	0.08	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	3.62 (at 1.92Å)	Xtriage
Refinement program	REFMAC 5.8.0073	Depositor
R, R_{free}	0.230 , 0.258 0.236 , 0.265	Depositor DCC
R_{free} test set	1679 reflections (4.75%)	wwPDB-VP
Wilson B-factor (Å ²)	20.8	Xtriage
Anisotropy	0.082	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.40 , 44.4	EDS
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.31$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.92	EDS
Total number of atoms	4603	wwPDB-VP
Average B, all atoms (Å ²)	25.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.24% of the height of the origin peak. No significant pseudotranslation is detected.*

¹Intensities estimated from amplitudes.

²Theoretical values of $\langle |L| \rangle$, $\langle L^2 \rangle$ for acentric reflections are 0.5, 0.333 respectively for untwinned datasets, and 0.375, 0.2 for perfectly twinned datasets.

5 Model quality

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: AKG, FE2

The Z score for a bond length (or angle) is the number of standard deviations the observed value is removed from the expected value. A bond length (or angle) with $|Z| > 5$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Chain	Bond lengths		Bond angles	
		RMSZ	# Z >5	RMSZ	# Z >5
1	A	0.30	0/2309	0.55	0/3145
1	B	0.30	0/2336	0.55	0/3182
All	All	0.30	0/4645	0.55	0/6327

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no planarity outliers.

5.2 Too-close contacts

In the following table, the Non-H and H(model) columns list the number of non-hydrogen atoms and hydrogen atoms in the chain respectively. The H(added) column lists the number of hydrogen atoms added and optimized by MolProbity. The Clashes column lists the number of clashes within the asymmetric unit, whereas Symm-Clashes lists symmetry related clashes.

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	A	2253	0	2246	11	0
1	B	2280	0	2271	11	0
2	A	1	0	0	0	0
2	B	1	0	0	0	0
3	A	10	0	4	0	0
3	B	10	0	4	0	0
4	A	25	0	0	0	0
4	B	23	0	0	0	0
All	All	4603	0	4525	21	0

The all-atom clashscore is defined as the number of clashes found per 1000 atoms (including hydrogen atoms). The all-atom clashscore for this structure is 2.

All (21) close contacts within the same asymmetric unit are listed below, sorted by their clash magnitude.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:275:ASP:OD2	1:B:62:ARG:NH1	2.37	0.58
1:A:286:ALA:HB3	1:A:289:SER:HB3	1.86	0.57
1:B:71:HIS:CE1	1:B:120:GLU:OE1	2.61	0.53
1:B:117:ARG:HB2	1:B:220:VAL:HG13	1.90	0.53
1:B:153:ILE:HG12	1:B:222:LEU:HD23	1.90	0.53
1:B:49:LEU:HD13	1:B:116:LEU:HD12	1.91	0.52
1:B:258:ARG:HG2	1:B:279:GLU:HB3	1.92	0.50
1:A:162:GLU:C	1:A:212:THR:HG23	2.31	0.50
1:B:120:GLU:O	1:B:123:MET:HG2	2.15	0.46
1:B:70:PRO:HA	1:B:71:HIS:HA	1.57	0.46
1:A:62:ARG:HB3	1:A:65:ALA:HB3	1.98	0.46
1:A:162:GLU:O	1:A:211:ARG:HB3	2.16	0.45
1:A:101:ALA:O	1:A:104:GLN:HB2	2.19	0.43
1:B:137:LEU:HD12	1:B:138:MET:N	2.34	0.43
1:A:286:ALA:HB3	1:A:289:SER:CB	2.48	0.42
1:A:249:VAL:CG2	1:A:289:SER:HB3	2.49	0.42
1:B:58:PRO:HD2	1:B:62:ARG:HE	1.84	0.42
1:A:210:ASN:OD1	1:A:212:THR:OG1	2.33	0.42
1:A:36:LEU:HD23	1:A:196:VAL:HG21	2.02	0.41
1:A:50:ASP:OD1	1:A:219:ARG:NH2	2.52	0.41
1:B:137:LEU:HD12	1:B:137:LEU:C	2.42	0.40

There are no symmetry-related clashes.

5.3 Torsion angles [i](#)

5.3.1 Protein backbone [i](#)

In the following table, the Percentiles column shows the percent Ramachandran outliers of the chain as a percentile score with respect to all X-ray entries followed by that with respect to entries of similar resolution.

The Analysed column shows the number of residues for which the backbone conformation was analysed, and the total number of residues.

Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	A	283/313 (90%)	274 (97%)	9 (3%)	0	100	100
1	B	287/313 (92%)	278 (97%)	9 (3%)	0	100	100
All	All	570/626 (91%)	552 (97%)	18 (3%)	0	100	100

There are no Ramachandran outliers to report.

5.3.2 Protein sidechains ⓘ

In the following table, the Percentiles column shows the percent sidechain outliers of the chain as a percentile score with respect to all X-ray entries followed by that with respect to entries of similar resolution.

The Analysed column shows the number of residues for which the sidechain conformation was analysed, and the total number of residues.

Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	A	247/271 (91%)	243 (98%)	4 (2%)	62	58
1	B	250/271 (92%)	244 (98%)	6 (2%)	49	41
All	All	497/542 (92%)	487 (98%)	10 (2%)	55	49

All (10) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	73	LYS
1	A	110	TRP
1	A	213	THR
1	A	289	SER
1	B	6	LYS
1	B	62	ARG
1	B	71	HIS
1	B	110	TRP
1	B	144	GLU
1	B	202	ARG

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (3) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	10	GLN
1	A	226	ASN
1	B	71	HIS

5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

5.4 Non-standard residues in protein, DNA, RNA chains [i](#)

There are no non-standard protein/DNA/RNA residues in this entry.

5.5 Carbohydrates [i](#)

There are no carbohydrates in this entry.

5.6 Ligand geometry [i](#)

Of 4 ligands modelled in this entry, 2 are monoatomic - leaving 2 for Mogul analysis.

In the following table, the Counts columns list the number of bonds (or angles) for which Mogul statistics could be retrieved, the number of bonds (or angles) that are observed in the model and the number of bonds (or angles) that are defined in the Chemical Component Dictionary. The Link column lists molecule types, if any, to which the group is linked. The Z score for a bond length (or angle) is the number of standard deviations the observed value is removed from the expected value. A bond length (or angle) with $|Z| > 2$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	$\# Z > 2$	Counts	RMSZ	$\# Z > 2$
3	AKG	B	302	2	3,9,9	0.31	0	4,11,11	0.68	0
3	AKG	A	302	2	3,9,9	0.60	0	4,11,11	0.64	0

In the following table, the Chirals column lists the number of chiral outliers, the number of chiral centers analysed, the number of these observed in the model and the number defined in the Chemical Component Dictionary. Similar counts are reported in the Torsion and Rings columns. '-' means no outliers of that kind were identified.

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
3	AKG	B	302	2	-	0/3/9/9	-
3	AKG	A	302	2	-	0/3/9/9	-

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

No monomer is involved in short contacts.

5.7 Other polymers [i](#)

There are no such residues in this entry.

5.8 Polymer linkage issues [i](#)

There are no chain breaks in this entry.

6 Fit of model and data ⓘ

6.1 Protein, DNA and RNA chains ⓘ

In the following table, the column labelled ‘#RSRZ> 2’ contains the number (and percentage) of RSRZ outliers, followed by percent RSRZ outliers for the chain as percentile scores relative to all X-ray entries and entries of similar resolution. The OWAB column contains the minimum, median, 95th percentile and maximum values of the occupancy-weighted average B-factor per residue. The column labelled ‘Q< 0.9’ lists the number of (and percentage) of residues with an average occupancy less than 0.9.

Mol	Chain	Analysed	<RSRZ>	#RSRZ>2		OWAB(Å ²)	Q<0.9
1	A	285/313 (91%)	0.79	26 (9%)	9 11	10, 22, 47, 71	0
1	B	289/313 (92%)	1.03	41 (14%)	2 2	11, 23, 53, 79	0
All	All	574/626 (91%)	0.91	67 (11%)	4 5	10, 22, 52, 79	0

All (67) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	291	ALA	16.1
1	A	290	PRO	13.3
1	B	290	PRO	13.2
1	B	5	SER	12.8
1	B	71	HIS	12.3
1	B	292	LEU	11.4
1	A	214	ALA	11.3
1	A	213	THR	10.1
1	B	4	ASP	7.4
1	A	289	SER	7.0
1	A	212	THR	6.7
1	B	59	LYS	6.4
1	A	59	LYS	6.3
1	B	70	PRO	5.9
1	B	69	PRO	5.6
1	A	72	PHE	5.5
1	A	216	LYS	5.5
1	B	289	SER	5.2
1	B	123	MET	5.1
1	B	6	LYS	4.9
1	A	211	ARG	4.9
1	A	56	PRO	4.7
1	A	71	HIS	4.6
1	B	214	ALA	4.5

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Mol	Chain	Res	Type	RSRZ
1	B	60	GLY	4.3
1	A	215	GLY	4.0
1	A	62	ARG	3.9
1	B	215	GLY	3.8
1	A	70	PRO	3.6
1	A	57	PRO	3.6
1	A	58	PRO	3.6
1	B	23	ARG	3.6
1	A	55	ILE	3.6
1	B	211	ARG	3.5
1	A	209	GLY	3.2
1	B	58	PRO	3.2
1	A	117	ARG	3.0
1	B	184	ASP	2.9
1	B	177	GLU	2.9
1	B	180	THR	2.8
1	B	7	PRO	2.8
1	A	60	GLY	2.8
1	B	74	TYR	2.8
1	B	216	LYS	2.7
1	B	122	GLY	2.7
1	B	72	PHE	2.7
1	B	128	PHE	2.7
1	B	283	GLN	2.5
1	B	213	THR	2.5
1	A	68	TYR	2.5
1	B	178	VAL	2.5
1	A	23	ARG	2.5
1	B	285	LYS	2.4
1	B	65	ALA	2.4
1	B	182	GLU	2.4
1	B	56	PRO	2.4
1	B	68	TYR	2.4
1	B	61	GLU	2.3
1	A	51	VAL	2.3
1	B	143	LEU	2.3
1	A	242	GLU	2.2
1	A	144	GLU	2.2
1	B	176	THR	2.1
1	B	139	HIS	2.1
1	B	208	GLY	2.0
1	A	158	GLU	2.0

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Mol	Chain	Res	Type	RSRZ
1	B	212	THR	2.0

6.2 Non-standard residues in protein, DNA, RNA chains [i](#)

There are no non-standard protein/DNA/RNA residues in this entry.

6.3 Carbohydrates [i](#)

There are no carbohydrates in this entry.

6.4 Ligands [i](#)

In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95th percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists the number of atoms with occupancy less than 0.9.

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å ²)	Q<0.9
3	AKG	A	302	10/10	0.77	0.23	33,34,35,35	0
3	AKG	B	302	10/10	0.95	0.11	22,23,24,24	0
2	FE2	A	301	1/1	0.98	0.11	30,30,30,30	0
2	FE2	B	301	1/1	0.99	0.09	26,26,26,26	0

6.5 Other polymers [i](#)

There are no such residues in this entry.